SR. VOTE CARD

Do we conserve energy by insulating Argylian homes?

Energy Production: If we reduce energy consumption 20% by insulating all 400,000 homes on Argyle, we could provide energy for an additional 80,000 homes without increasing air pollution.

Energy Source: Conservation means voluntarily reducing your energy use. Conservation cuts the need for energy from all sources.

Pollution: Conservation reduces reliance on polluting energy sources, but some insulating materials are made from toxic substances at polluting factories.

Greehouse Effect: Energy conservation reduces reliance on greenhouse gas-producing energy sources.

Land & Wildlife: Conserving energy will ultimately preserve land.

Investment Cost: $75 million (pc=$75)

Hidden Costs: Possible indoor air quality problems from insulation materials and inadequate air exchange.

Revenues: More comfortable homes; money spent in local economy rather than on foreign fuel supplies; will pay for itself in 3 to 10 years in reduced heating and cooling costs.

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

SR. VOTE CARD

Do we build a nuclear power plant at Figtown?

Energy Production: 600 MW

Energy Source: Nuclear power plants use heat from atomic reactions to run steam generators, which make electricity. Nuclear fuels like uranium are **nonrenewable resources**.

Pollution: Nuclear power plants do not produce air pollution. Radioactive nuclear fuel is dangerous and must be disposed of in special sites. Fallout from a meltdown would devastate Argyle.

Greenhouse Effect: Nuclear power does not produce any greenhouse gases.

Land & Wildlife: The site of the plant, mining of uranium and disposing of spent fuel requires a large land area for safety. Warm water discharged from cooling the reactor disrupts aquatic habitats.

Investment Cost: $1.2 billion ($2000/KW) (pc=$1200)

Hidden Costs: Dismantling and disposing of the plant at the end of its life; disposing of spent fuel; mining and transporting fuel to the plant; accidents at the plant.

Revenues: Creation of jobs to build and run the plant;

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

SR. VOTE CARD

Do we drill for natural gas in the Wiggly Ocean and build a pipeline?

Energy Production: Geologists estimate that enough natural gas exists in offshore reserves to heat homes and power factories on Argyle for 15-25 years.

Energy Source: Natural Gas is found by drilling beneath the ground or the ocean floor. Near the Bing Islands there are large deposits of natural gas. Natural gas is a **nonrenewable resource.**

Pollution: Natural gas has lower pollution emissions than oil or coal.

Greenhouse Effect: 31.9 lb of CO2/million Btu

Land & Wildlife: a pipeline from the east coast to Figtown would cut a 75-foot wide swath through Wildwoods National Park, nearby woods, waterways and farmland, and displace some homes; drilling may damage habitat for marine mammals around Bing Islands.

Investment Cost: $460 million (drilling and pipeline construction) (pc=$460)

Hidden Costs: possible spills or leaks; lost or damaged habitat along pipeline; lower property values along pipeline.

Revenues: Jobs to build pipeline; lower CO2 emissions; cleaner-burning fuel;

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

ROLE CARD

Each team member will play one (or more than one if the team has fewer than four players) of the following roles:

The FACILITATOR will:

- play the role of "Chair" of the legislative body ensuring everyone participates and is treated fairly and with respect.
- make sure everyone understands and is doing his/her job
- conduct the vote and read the status sheets after the group votes.
- lead the group presentation at games end and assist the group with the self assessment process.

The RECORDER will:

- Record each voting issue and the reasons for or against the issue on the Record card.
- record the result of the vote on the Record card.
- keep running tally of Argyle's energy mix and caluclate the per capita costs for each energy project chosen
- Share the voting results with the rest of the class during the wrap-up period.

SR. VOTE CARD

Do we build a small hydropower dam on the Lute River?

Energy Production: 25 MW

Energy Source: Hydroelectric plants generate electricity by using falling water to turn turbines. Hydroelectric dams store water in a reservoir. Water is a **renewable resource**.

Pollution: Hydro power does not emit any air pollutants.

Greenhouse Effect: CO2 and methane are emitted from the bacterial decomposition of flooded-out vegetation.

Land & Wildlife: The dam will flood out the town of Glenn, displace 8000 residents; destroy some of the habitat for the endangered Argyle Wooly Cat and block passages for fish stocks.

Investment Cost: $70 million ($2800/KW) (pc=$70)

Hidden Costs: Loss of river-based tourism; resettling 8000 residents; replacing habitat losses for the fish and the Argyle Wooly Cat; dam maintenance; possibility of mercury being released from soil into water and fish; electricity price increase to 8¢/KWH

Revenues: temporary labor jobs during construction and technical jobs to operate plant; lake-based tourism; habitat for water birds.

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

SR. VOTE CARD

Do we finance a 4000-rooftop solar electricity generation program in Tonga?

Energy Production: Each rooftop solar system will generate 2-4 kW of power, feeding a total of 8-16 MW into the grid.

Energy Source: Photovoltaic (PV) panels made from purified silicon chips generate electricity when exposed to energy from the sun, a **renewable resource**.

Pollution: Solar electricity emits no pollutants, however, making PV panels requires the use of some hazardous materials and nonrenewable resources.

Greenhouse Effect: PV electricity emits no greenhouse gases.

Land & Wildlife: PV panels will be placed on existing rooftops, requiring no additional land usage.

Investment Cost: $84.8 million ($5300/KW)(pc=$85)

Hidden Costs: PV homes will pay an additional $4 per bill for the panels; customers will pay 1¢ more per KWH.

Revenues: Improved air quality; higher property values for PV homes.

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

SR. VOTE CARD

Do we build a 600-machine wind farm on Argyle's mountains?

Energy Production: 300 MW

Energy Source: Wind machines use turning blades to collect the wind's energy. The blades connect to a drive shaft that turns a generator to make electricity. The Argyle mountain tops have wind conditions favorable for a wind farm location. Wind is a **renewable resource**.

Pollution: Wind machines cause no air or water pollution.

Greenhouse Effect: Wind machines produce no greenhouse gases.

Land & Wildlife: often built in migratory bird flyway; birds can be killed or injured by wind machine turbines; some people find wind farms are unattractive noisy; wind power requires less than half the land area required by coal power.

Investment Cost: $300 million ($1000/KW) (pc=$300)

Hidden Costs: Potential loss of hiking/camping tourism; obscured view of the mountains; electricity price increase to 7.5¢/KWH.

Revenues: Local jobs created for construction and maintenance; reduced pollution-caused health care costs; wind farm as a tourist attraction.

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

SR. VOTE CARD

Do we drill for oil in the Ocean of Emotion?

Energy Production: Geologists estimate over 5 million barrels of oil lie off the south coast—enough for 5 years' worth of gasoline for all Argylians.

Energy Source: Oil is found by drilling wells beneath the ground or the ocean floor. We use oil to make gasoline and many consumer products, including plastics. Oil is a **nonrenewable resource.**

Pollution: When burned to create energy, oil emits NOx, SO2, volatile organic compounds, hydrocarbons and other hazardous air pollutants.

Greenhouse Effect: Oil emits 44.0 lb CO2/million Btu

Land & Wildlife: An oil spill could damage the marine environment, killing plants and animals.

Investment Cost: $75 million ($15/barrel) (pc=$75)

Hidden Costs: Potential spill cleanup; pollution caused health problems; transportation; refining.

Revenues: jobs on the oil rig and at the refinery; reduced reliance of foreign oil.

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

STATUS REPORT
Nuclear Power

If you voted YES:
Energy: You created a major energy source. **Gain 4.**

Environment: The nuclear power plant has replaced some of the need for fossil fuel on Argyle, improving air quality. However, spent nuclear fuel is a serious threat to the environment. **Lose 3.**

Economy: The nuclear power plant was expensive and the challenge of what to do with the nuclear waste will cost even more money, consumer electricity rates doubled after the plant closed to recover the cost of dismantling it and finding storage for the hazardous nuclear wastes. **Lose 4**

If you voted NO:
Energy: You lost your chance for a major energy source. **Lose 4**.

Environment: By not building the nuclear plant you have avoided the problem of what to do with the spent fuel, but fossil fuel usage continues to harm air quality. **Gain 2.**

Economy: Although crops damaged by continued acid rain cost the farmers money, you saved millions by not building the nuclear power plant. **Gain 4.**

STATUS REPORT
Insulation

If you voted YES:
Energy: Congratulations! By insulating the homes of Argyle, you saved a lot of energy. **Gain 2.**

Environment: Because people use less energy to heat their homes, there was less pollution from fossil fuels and air quality improved. **Gain 2.**

Economy: Insulting homes was expensive, but the initial cost paid for itself in reduced heating bills. **Gain 2.**

If you voted NO:
Energy: Argyle had a very cold winter. You used even more energy than normal. **Lose 2.**

Environment: Increased winter use of fossil fuels caused much pollution; air quality suffered and many Argylians went to the hospital with lung problems. **Lose 2.**

Economy: The additional use of energy through the winter cost Argylians a lot in added heating bills. **Lose 2.**

ROLE CARD

The MAP MAKER will:
- use a grease pencil or dry erase marker to draw the result of each vote on a piece of mylar covering the map. For instance, if the vote results in a hydro dam being built, draw the dam and reservoir on the map.
- report and point out the locations where energy sources were placed at the end of the game.

The SCORE KEEPER will:
- make sure the group does not go bankrupt, have a blackout, and does not destroy the environment beyond repair
- keep track of the energy, environment and economy points by moving the token up and down the scales.

The SCOREKEEPER is in charge of keeping track of where their tokens are on the scale, in case the game gets bumped and their tokens fall off. (To avoid errors, you can use tiny sticky notes instead of tokens to keep the score.)

STATUS REPORT
Natural Gas Drilling and Pipeline

If you voted yes:
Energy: You provided heat for all Argyle residents, but natural gas reserves turned out to be lower than expected, lasting only 13 years. **Gain 3.**

Environment: Recently developed technology for heating homes with natural gas is much more efficient. The result is a more complete combustion with fewer pollutants being released into the air. Air quality has improved, but a lot of land has been altered or damaged by the pipeline, and the fishing community on the Bing Islands has suffered from damaged coral reefs and lower catches due to drilling. **Gain 1.**

Economy: The plan was expensive and didn't last as long as expected. **Lose 2.**

If you voted no:
Energy: Argyle's industry needed this energy resource. Now they have to import fuel from another country. **Lose 3.**

Environment: Argyle's residents continue to heat using dirtier fuels, but you preserved important habitats along the pipeline corridor and in the marine fishery. **Lose 1.**

Economy: The cost of importing fuel is high. **Lose 2.**

STATUS REPORT
Solar Rooftops

If you voted YES:
Energy: You gained a steady supply of electricity. **Gain 2.**

Environment: You reduced reliance on nonrenewable and polluting energy sources, but pollutant emissions from manufacturing photovoltaic panels has increased. **Gain 2.**

Economy: Installing solar panels was expensive, but voluntary bill increases from enthusiastic consumers made up for some of the difference. **Lose 1.**

If you voted NO:
Energy: You missed your chance to invest in an alternative energy source. **Lose 2.**

Environment: You continue to rely on polluting energy sources and greenhouse gases are building up faster every day. **Lose 3.**

Economy: You saved a lot of money, but health care rates continue to go up in Tonga as more people suffer from lung ailments. **Gain 1.**

STATUS REPORT
Hydroelectric Dam

If you voted YES:
Energy: You created a reliable source of electricity production. **Gain 3.**

Environment: You replaced a polluting fossil fuel plant with clean water power, but you destroyed almost half of the habitat for an endangered species, flooded an historic town, blocked the passage for fish and the new lake has become contaminated by mercury from the newly saturated soil. **Lose 2.**

Economy: Building the dam cost you a lot, but you created a steady source of electricity that will be around for a long time. **Gain 2.**

If you voted NO:
Energy: You missed a chance to gain a reliable source of electricity. **Lose 3.**

Environment: You continue to rely on a polluting fossil fuel plant, but you protected an endangered species, an historic town and important fish stocks. **Gain 2.**

Economy: You saved money by not building the dam, but your current electricity source costs more than hydro would have. **Gain 2.**

STATUS REPORT
Drilling for Oil

If you voted YES:
Energy: You provided gasoline for almost sixty years. **Gain 3.**

Environment: Oil spilled at the well site killed off the Weeping Heron, a national treasure, and impacted the marine ecosystem. **Lose 5.**

Economy: The plan cost a lot, and unexpected environmental costs and fishery losses added even more, but surplus oil has brought needed capital to the island. **No net loss or gain.**

If you voted NO:
Energy: The country you import oil from went to war, resulting in an oil shortage. L**ose 3.**

Environment: You did not pollute the water with spilled oil and saved the weeping crane and island fisheries. **Gain 3.**

Economy: You saved a lot by not drilling for oil, but the oil shortage has nearly doubled gas prices. **No net loss or gain.**

STATUS REPORT
Wind Farm

If you voted YES:
Energy: You created a steady supply of energy. **Gain 2.**

Environment: Wind power has helped reduce air pollution and greenhouse gas emissions. Bird kills were reduced by locating the wind machines out of migrating bird flyways, by using radar to detect birds and by building tube-shaped towers rather than horizontal supports which tend to be attractive bird perches. **Gain 2.**

Economy: Your wind farm produces energy fairly cheaply. **Gain 2**.

If you voted NO:
Energy: You could not supply enough energy for air conditioning this summer and had to reduce power, resulting in brownouts. **Lose 2.**

Environment: You continue to rely on polluting and greenhouse gas emitting fuels. **Lose 2.**

Economy: Continued pollution drives up costs of health care, **Lose 2.**

SR. VOTE CARD

Do we add three hydrogen fuel cell buses to the public bus system?

Energy Production: Hydrogen fuel-cell powered buses are 46% efficient, compared to diesel's 20% efficiency.

Energy Source: Hydrogen can be made by splitting water into oxygen and hydrogen using electricity. Hydrogen from water is a **renewable resource.**

Pollution: Fuel-cell vehicles emit no pollution. The only by-product is water vapor. Bus use will reduce pollution from personal vehicles

Greenhouse Effect: Fuel cells produce no greenhouse gases.

Land & Wildlife: Use of hydrogen reduces the need for oil drilling and the effects of oil spills on land and wildlife.

Investment Cost: $9.6 million

Hidden Costs: The bus garage will need to be outfitted with noncombustible storage areas for the hydrogen buses, a special refueling area and increased ventilation.

Revenue: Argyle will be on the forefront of an exciting new technology; reduced reliance on foreign fuels; fuel cells will become cheaper with greater usage.

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not turn over this card until *after* the vote.

SR. VOTE CARD

Do we convert half of our gasoline pumps to ethanol pumps?

(Note: If you've already converted to electric vehicles, you may discard this vote card and select another.)

Energy Production: Argyle can produce enough ethanol to fuel half of the cars on the island; ethanol is almost twice as efficient to produce as gasoline.

Energy Source: Ethanol is produced through the fermentation of corn wheat or sugar cane, all **renewable resources**.

Pollution: Ethanol-powered vehicles emit less CO than gas, but may increase SO2 and NOx emissions.

Greenhouse Effect: The use of traditional methods of agriculture (petroleum-based fertilizers, machinery, etc.) to grow ethanol crops may actually emit more CO2 than gasoline (>42.8 lb CO2/mil Btu).

Land & Wildlife: Farmers may have to convert land to grow fuel crops.

Investment Cost: $4.5 million

Hidden Costs: May shift petroleum consumption and greenhouse gas emissions from vehicles to the agriculture industry. Without government subsidy, ethanol could not compete with gasoline.

Revenue: Reduced reliance on foreign fuels; growth of local agriculture and ethanol refining industry.

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

SR. VOTE CARD

Do we use passive solar design in the new Bunk City Hall?

Energy Production: Passive solar design can save 30% to 50% of heating energy and costs.

Energy Source: Passive solar design uses southern orientation, south-facing windows and overhangs, heat absorbing material, and insulation to capture and store the sun's heat, a **renewable resource.**

Pollution: Passive solar reduces dependence on polluting heat sources.

Greenhouse Effect: Passive solar reduces dependence on greenhouse gas emitting heat sources.

Land Consumption: A passive solar design requires certain sites with southern orientation, but no additional land area.

Investment Cost: The passive solar design will cost $50,000 over the building's planned $1 million budget.

Hidden Costs: Possible heat loss from additional windows.

Revenue: Natural daylighting in the design will improve worker comfort and health and increase productivity.

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

SR. VOTE CARD

Do we build a geothermal electricity plant near Steamy Hot Springs?

Energy Production: 100 MW

Energy Source: Hot water is brought to the surface from underground and flashed to steam. The steam turns a turbine engine which turns a generator. Spent water is reinjected into the well. Geothermal is a r**enewable resource** if recharged and managed properly.

Pollution: Geothermal emits less NOx, and at only a few percent of the SO2 that fossil fuel plants emit; potential for toxic emissions.

Greenhouse Effect: generates .087 lb CO2/million Btu

Land & Wildlife: Geothermal plants require only a fraction of the land needed by other energy generators and can commingle safely with other land uses.

Investment Cost: $200 million ($2000/kW)

Hidden Costs: frequent replacement of plant equipment due to corrosion; possible adverse effects on nearby Steamy Hot Springs, a popular tourist spot.

Revenues: Reduced reliance on foreign and nonrenewable resources; reduced pollution and CO2 emissions.

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until after the vote.

SR. VOTE CARD

Do we convert all of Argyle's vehicles (80,000) to electric power?

(Note: If you've already converted to ethanol
you may wish to discard this vote card and select another.)

Energy Production: Electric vehicles **(EV's)** get over twice the mileage of internal combustion engines from an equivalent amount of energy.

Energy Source: EV's get their power from batteries, rather than an internal combustion engine **(ICE)**. The batteries must be charged by an existing electricity source.

Pollution: EV's emit no pollutants directly, but they may be charged by a polluting electricity source.

Greenhouse Effect: EV's emit no greenhouse gases directly, but their electricity source may emit greenhouse gases.

Land & Wildlife: Argyle would have to build EV charging stations, or convert gas stations to charging stations.

Investment Cost: $320 million

Hidden Costs: batteries need replacement every 3-5 years; EV's can travel only a limited distance per charge (40-70 miles);

Revenues: EV's are quiet; it is cheaper to charge an EV than to gas up an ICE vehicle; EV maintenance costs are half that of ICE's.

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

SR. VOTE CARD

Should we build a biomass cogeneration plant in West Lulu?

Energy Production: 25 MW electricity plus heat to 3000 (or 12%) of Argyles homes. Cogeneration is twice as efficient as electricity-only generation. The heat or hot water generated would be sold to a nearby industry facility.

Energy Source: BioEnergy plants burn plant matter to create hot water and electricity. W. Lulu's plant would burn sunflower seed shells from nearby farms and wood chips from city pruning projects. BioEnergy is a **renewable resource.**

Pollution: Biomass emits 5% of the NOx that gas emits; 15% of the CO that vehicles emit; and 30% of the particulates coal emits.

Greenhouse Effect: There are no net emissions of CO2 because emissions are compensated for by CO2 absorbed during growth.

Land & Wildlife: The BioEnergy plant should burn existing waste products and not require the additional growth or cutting of fuel.

Investment Cost: $4.4 million ($1800/kW)

Hidden Costs: Potential for deforestation for fuel if wood and agricultural wastes do not meet demand.

Revenues: eliminating waste disposal problems; reducing reliance on nonrenewable resources;

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

SR. VOTE CARD

Do we install geothermal air-source heat pumps (GHPs) in 4000 homes and businesses?

Energy Production: Savings of 12 MW.

Energy Source: GHPs use a loop of plastic pipe filled with water and antifreeze and placed over 100 feet deep to transfer normal groundwater temperatures for winter heating, summer cooling and hot water heating. Ground heat is a **renewable resource.**

Pollution: GHPs emit no pollution; there is no contact between the antifreeze solution and the groundwater.

Greenhouse Effect: GHPs emit no greenhouse gases.

Land & Wildlife: GHPs take up the space of a normal gas furnace.

Investment Cost: $40 million ($3000/kW saved)

Hidden Costs: GHPs may need to be supplemented with other heating and cooling sources.

Revenue: reduced dependence on polluting heat sources; improved air quality;

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

SR. EXTRA VOTE CARD

Use this card to research your own energy issue.

Energy Production:

Energy Source

Pollution:

Greenhouse Effect:

Land & Wildlife:

Investment Cost:

Hidden Costs:

Revenue:

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of this card until *after* the vote.

STATUS REPORT
Biomass Plant

If you voted YES:
Energy: You created a steady, local source of energy, gain 3.

Environment: You have solved a solid waste disposal problem, at the same time utilizing a renewable, lower-polluting resource, **gain 1.**

Economy: The plant was pretty inexpensive to build and using wood and agricultural wastes is much cheaper than mining coal, however, the biomass supplies run low and now require lumber which is becoming a waste of a precious natural resource, **lose 1.**

If you voted NO:
Energy: You can't keep up with energy demand on the island, **Lose 1.**

Environment: Acid rain is an increasing problem on the island, and the coal mines are having devastating effects on Argyle's mountains and forests, **lose 3.**

Economy: The oil and coal industries are booming, gain **2.**

STATUS REPORT
Electric Vehicles

If you voted YES:
Energy: It took more time than planned for the citizens of Argyle to accept the conversion to electric vehicles. Thus not as much energy was saved as had been hoped. **Gain 2.**

Environment: Air quality in the cities has improved greatly. **Gain 2.**

Economy: Converting to EVs was expensive and charging them has increased household electricity costs, but saved on gasoline expenses. Environmental health problems have decreased. **Gain 2.**

If you voted NO:
Energy: You saved electricity, but continue to use gasoline, which has grown scarce, due to an oil embargo, **Lose 2.**

Environment: Air quality has gotten worse, more people have been hospitalized for lung disease. **Lose 2.**

Economy: You saved money by not purchasing EVs, but gasoline expenses have gone up and the cost of health care to cover people suffering from long disease is high. **Gain 1.**

EXTRA STATUS REPORT

If you voted YES:
Energy:

Environment:

Economy:

If you voted NO:
Energy:

Environment:

Economy:

STATUS REPORT
Geothermal Heat Pumps

If you voted yes:
Energy: You have taken a major load off of the fossil fuel based energy grid in many households, **gain 2.**

Environment: Geothermal heat pumps (GHPs) have reduced the use of polluting energy sources without damaging any land or wildlife resources, **gain 3.**

Economy: The GHPs were very expensive, but the should pay themselves off in reduced heating costs in less than 10 years, **lose 1.**

If you voted no:
Energy: The fossil fuel based energy grid on Argyle continues to strain under the burden of high demand, **lose 2.**

Environment: Unless you have earlier chosen a conversion to solar roof tops, most homes continue to rely on polluting energy sources, **lose 3.**

Economy: You saved a lot of money by not investing in GHPs, but continue to pay high heating bills, **gain 2.**

STATUS REPORT
Ethanol Pumps

If you voted YES:
Energy: Ethanol has proved to be another energy source for the island, reducing the impacts of an oil shortage, **gain 3.**

Environment: Carbon monoxide levels have improved somewhat, but farmland has degraded due to poor farming practices on fuel crop lands, but shipping costs to deliver ethanol has resulted in increased air pollution, **lose 1.**

Economy: Unexpected shipping costs distributing ethanol across the country have increased air quality emissions and increased the cost of the fuel, **lose 1**

If you voted NO:
Energy: An oil shortage caused long lines at gas stations, **lose 3.**

Environment: Carbon monoxide levels remain high in some Argyle cities, **lose 1.**

Economy: Although gas prices went up due to the oil shortage you did not have to increase taxes to pay for ethanol development costs, **gain 1**.

STATUS REPORT
Hydrogen Buses

If you voted YES:
Energy: You are now able to fuel 5% of the Bunk bus fleet without dependence of foreign fuels. However, as in learning how to use any new technology, there have been some mechanical problems and these buses have been in the garage a lot for repairs, **gain 2.**

Environment: Hydrogen produced from water is a zero emission fuel, the buses will help clean up Bunk's air, **gain 2.**

Economy: The bus project has been expensive, but hydrogen research will benefit from your experiment, **lose 2.**

If you voted NO:
Energy: Your entire bus fleet continues to rely on fossil fuels, which might decline in the near future, **lose 2.**

Environment: Diesel fumes from the buses cause lung problems for many people in Bunk, **lose 2.**

Economy: You saved a lot of money by not investing in hydrogen fleets, **gain 2.**

STATUS REPORT
Geothermal Electricity

If you voted YES:
Energy: You created a major energy source for the island, **gain 2.**

Environment: Air quality has improved greatly in the areas the geothermal plant serves, and the hot springs have not shown any negative effects so far, **gain 3.**

Economy: Despite high maintenance costs, the geothermal plant has created numerous jobs for islanders, **gain 1.**

If you voted NO:
Energy: You missed your chance at a major energy source, **lose 2.**

Environment: The geothermal plant could have solved a lot of air quality problems on the southern half of the island, **lose 3.**

Economy: You saved a lot by not building the plant, but the price of fossil fuels has continued to rise, and the unemployment rate on Argyle is high, **gain 1.**

STATUS REPORT
Passive Solar

If you voted YES:
Energy: You saved 25% on energy usage in the new city hall, officials plan on using passive solar design in all future projects, when feasible, **gain 2.**

Environment: You reduced reliance on polluting energy sources, **gain 2.**

Economy: The addition of solar design cost $50,000, but saved almost half of the building's heating costs, **gain 2.**

If you voted NO:
Energy: You missed your chance to take advantage of free solar energy, now you have to increase Argyles electric generating capacity to meet the needs of the new building, **lose 2.**

Environment: You continue to rely on polluting energy sources, **lose 2.**

Economy: You saved money but the heating bills for the City Hall are higher than they would have been with passive solar design, **gain 1.**

JR. VOTE CARD

Do we build a hydropower dam on the Lute River?

Hydropower: Moving water has been used as a source of energy for thousands of years. Today, hydroelectric plants generate electricity by using falling water to turn turbines. Hydroelectric dams store water in a reservoir. Water is a **renewable resource**.

Fact: A hydroelectric plant will improve air quality on argyle and reduce greenhouse gas emissions by reducing the island's reliance on fossil fuels for energy.

Fact: The dam will flood out the town of Glenn, displace 8000 residents; destroy some of the habitat for the endangered Argyle Wooly Cat and block passages for fish stocks.

Fact: hydropower requires 20 times more land area than solar power.

Investment Cost: $70 million (pc=$70)

Energy Production: 25 megawatts of power.

Discuss this issue for 5-10 minutes, then voteYES or NO.
Do not look at the back of the card until *after* the vote.

JR. VOTE CARD

Do we finance a 4000-rooftop solar electricity generation program?

Solar Electricity: Energy from the sun is converted to electricity by photovoltaic (PV) panels made from purified silicon chips. The sun is a **renewable resource**.

Fact: Solar electricity emits no pollutants or greenhouse gases; however, making PV panels requires the use of some hazardous chemicals and non-renewable resources.

Fact: PV panels will be placed on existing rooftops, requiring no additional land usage.

Investment Cost: $84.8 million ($5300/kW)(pc=$84.80)

Energy Production: 16 megawatts of power

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

JR. VOTE CARD

Do we build a 600-machine wind farm on Argyle's mountains?

Wind Power: Wind machines use turning blades to collect the wind's energy. The blades connect to a drive shaft that turns a generator to make electricity. The Argyle mountain tops have wind conditions favorable for a wind farm location. Wind is a **renewable resource**.

Fact: Wind machines cause no air or water polluion and produce no greenhouse gases.

Fact: Birds can be killed or injured by wind machine turbines;

Fact: Some people find wind farms are unattractive and noisy.

Fact: Wind power requires less than half the land area required by coal power.

Investment Cost: $300 million ($1000/kw) (pc=$300)

Energy Production: 300 megawatts of power.
Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

JR. VOTE CARD

Do we drill for oil in the Wiggly Ocean?

Oil: Oil is found by drilling wells beneath the ground or the ocean floor. We use oil to make gasoline and many consumer products, including plastics. Oil is a **non-renewable resource.**

Fact: When burned to create energy, oil forms products that can harm humans and most other life forms and add to global climate change.

Fact: An oil spill could damage the marine envrironment, killing plants and animals.

Investment Cost: $75 million (pc=$75)

Environmental Cost: Potential spill cleanup; pollution caused health problems; transportation; refining.

Energy Production: Geologists estimate that enough oil lies off the south coast to provide Argyle with 5 years' worth of gasoline.

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

JR. VOTE CARD

Do we invest in conserving energy by insulating Argylian homes?

Energy Conservation: Conservation means voluntarily reducing your energy use by installing insulation, replacing old windows, hanging thermal curtains and lowering thermostats, etc.

Fact: Conservation cuts the need for energy from all sources.

Fact: Conservation reduces reliance on polluting and greenhouse gas emitting energy sources, but some insulating materials are made from toxic substances at polluting factories.

Fact: Energy conservation requires up-front costs that can be scary to consumers.

Investment Cost: $75 million (pc=$75)

Energy Production: If we reduce energy consumption by 20% through conservation, we could provide enough energy to power an additonal 80,000 homes on Argyle with no increase in air pollution.

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

JR. VOTE CARD

Do we build a nuclear power plant at Figtown?

Nuclear Power: Nuclear power plants use heat from atomic reactions to run steam generators, which make electricity. Nuclear fuels like uranium and plutonium are **non-renewable resources**.

Fact: Nuclear power plants do not produce air pollution or any greenhouse gases.

Fact: Radioactive nuclear fuel is dangerous and must be disposed of in special sites. Fallout from a meltdown would devastate Argyle, causing many cancers and radiation health effects on the population.

Investment Cost: $1.2 billion (pc=$1200)

Energy Production: 600 megawatts of electrical power

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

JR. VOTE CARD

Do we drill for natural gas in the Wiggly Ocean and build a pipeline?

Natural Gas is found by drilling beneath the ground or the ocean floor. Near the Bing Islands there are large deposits of natural gas. Natural gas is a **non-renewable resource.**

Fact: Natural gas emits less pollution and less carbon dioxide than coal and oil.

Fact: Building a pipeline from the east coast to Figtown would cut a 75-foot wide swath through Wildwoods National Park and nearby woods and farmland, displacing some homes.

Investment Cost: $460 million (pc=$460)

Energy Production: geologists estimate enough natural gas exists in offshore reserves to heat homes and power factories on Argyle for 15-25 years.

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

ROLE CARD

Each team member can play one (or more than one if the team has fewer than four players) of the following roles:

The FACILITATOR will:

- play the role of "Chair" of the legislative body by ensuring everyone participates and is treated fairly and with respect.
- make sure everyone is doing his/her job
- after the player who lands on the Vote square reads the vote card, the Facilitator conducts the vote and reads the status sheets.)
- leads the group presentation at games end and assists the group self assessment if required by the teacher.

The RECORDER will:

- Record each voting issue and the reasons for or against the issue on the Record card.
- record the result of the vote on the Record card.
- keep a running tally of the energy 'mix' and per capita (pc) investment costs.

JR. VOTE CARD

Do we add three hydrogen fuel cell buses to the public bus system?

Hydrogen can be made by splitting water into oxygen and hydrogen using electricity. Hydrogen from water is a **renewable resource.**

Fact: Fuel-cell vehicles emit no pollution and no green-house gases. The only by-product is water vapor. Bus use will reduce pollution from personal vehicles.

Land & Wildlife: Use of hydrogen reduces the need for oil drilling and the effects of oil spills on land and wildlife.

Investment Cost: $9.6 million (pc=$9.60)

Energy Production: Hydrogen fuel-cell powered buses are 46% efficient, compared to diesel's 20% efficiency.

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not turn over this card until *after* the vote.

JR. VOTE CARD

Do we convert half our gasoline pumps to ethanol?

(Note: If you already converted to electric vehicles, you may discard this vote card and select another.)

Ethanol is produced through the fermentation of corn, wheat or sugar cane, all **renewable resources**.

Pollution: Ethanol-powered vehicles emit less CO than gas, but may increase SO2 and NOx emissions.

Facts: The use of traditional methods of agriculture (petrolium-based fertilizers, machinery, etc.) to grow ethanol crops may actually emit more CO2 than gasoline (>42.8 lb CO2/million Btu)

Fact: Farmers may have to convert land to grow fuel crops.

Investment Cost: $4.5 million (pc=$4.50)

Energy Production: Argyle can produce enough ethanol to fuel half of the cars on the island.

Discuss this issue for 5-10 minutes, then vote YES or NO.

JR. VOTE CARD

Do we use passive solar design in the new Bunk City Hall?

Passive solar design uses southern orientation, south-facing windows and overhangs, heat absorbing material, and insulation to capture and store the sun's heat, a **renewable resource.**

Fact: Passive solar reduces dependence on polluting and greenhouse gas emitting heat sources.

Fact: A passive solar design requires certain sites with southern orientation, but no additional land area.

Investment Cost: The solar design will increase the building cost $50,000 over the original $1 million budget. (pc=$1.00 + 5 cent increase)

Energy Production: Passive solar design can save 10% to 40% of heating energy needs and costs.

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

JR. VOTE CARD

Do we build a geothermal electricity plant near Steamy Hot Springs?

Geothermal Power: Hot water is brought to the surface from underground and flashed to steam. The steam turns a turbine engine which turns a generator. Spent water is reinjected into the well. Geothermal is a r**enewable resource** if recharged and managed properly.

Pollution: Geothermal emits much less pollution than fossil fuel plants and only a fraction of the carbon dioxide.

Fact: Geothermal plants require only a fraction of the land needed by other energy generators and can commingle safely with other land uses.

Fact: Many people are concerned that a geothermal power plant might damage nearby Steamy Hot Springs, a popular tourist spot.

Investment Cost: $200 million ($2000/kW) (pc=$200)

Energy Production: 100 MW

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

JR. VOTE CARD

Do we convert all of Argyle's vehicles (80,000) to electric power? (Note: If you've already converted to ethanol, you may discard this vote card and select another.)

Electric Vehicles (EVs) get their power from batteries, rather than an internal combustion engine (ICE). The batteries must be charged by an existing electricity source.

Fact: EV's emit no pollutants or greenhouse gases directly, but they may be charged by a polluting electricity source.

Fact: Argyle would have to build EV charging stations, or convert gas stations to charging stations.

Investment Cost: $320 million (pc=$320)

Energy Production: Electric vehicles (EV's) get over twice the mileage of internal combustion engines from an equivalent amount of energy.

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

JR. VOTE CARD

Should we build a biomass cogeneration plant in West Lulu?

The BioEnergy plant will burn plant matter to generate both hot water and electricity. W. Lulu's plant would burn sunflower seed shells from nearby farms and wood chips from forestry pruning projects. The heat or hot water would be sold to a nearby industrial park. BioEnergy is a **renewable resource.**

Fact: New Biomass plants emit fewer pollutants than older coal, gasoline and oil burning plants.

Fact: There are no net emissions of carbon dioxide because emissions are compensated for by CO2 absorbed during growth.

Fact: The BioEnergy plant should burn existing waste products and not require additional growth or cutting of fuel.

Investment Cost: $4.4 million ($1800/kw) (pc=$4.40)

Energy Production: 25 mw electricity to **3000** or about 12% of Argyles homes and space heat and hot water for the entire industrial park. Cogeneration, which produces both heat and electricity, is more efficient than electricity-only generation.

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

JR. VOTE CARD

Do we install geothermal air-source heat pumps (GHPs) in 4000 homes and businesses?

Geothermal Heat Pumps use a loop of plastic pipe filled with water and antifreeze and placed over 100 feet deep to transfer normal groundwater temperatures for winter heating, summer cooling and hot water heating. Ground heat is a **renewable resource.**

Fact: GHPs emit no pollution and no greenhouse gases; there is no contact between the antifreeze solution and the groundwater.

Fact: GHPs take up the space of a normal gas furnace, not adding any pressures to land and wildlife issues.

Investment Cost: $40 million ($3000/kw saved)(pc=$40)

Energy Production: Savings of 12 mw.

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of the card until *after* the vote.

JR. EXTRA VOTE CARD

Use this card to research your own energy issue.

Energy Source:

Fact:

Fact:

Fact:

Investment Cost:

Energy Production:

Discuss this issue for 5-10 minutes, then vote YES or NO.
Do not look at the back of this card until *after* the vote.